

BOTANY.—*New or imperfectly known species of bull-horn acacias.*

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In 1914 the writer published a preliminary paper on the myrmecophilous acacias of tropical America commonly called bull-horns.¹ The present paper is intended as a supplement to it. Additional material has been received from various sources, including specimens from the herbarium of the Missouri Botanical Garden collected in Mexico by Dr. Josiah Gregg in 1849, and others from the Isthmus of Panama, collected recently by Mr. Henry Pittier.

An undescribed species very closely related to *Acacia Standleyi* and to *A. hirtipes* must be assigned to the section *Clavigerae*. The fact that the large spines of this new species are quite glabrous makes it advisable that the group name *Hebacanthae*, which includes these species, be changed; and the name *Mesopodiales* is therefore proposed herewith as a substitute for it. As modified the group may be redescribed as follows:

Group V. MESOPODIALES (*Hebacanthae* Safford, op. cit., p. 366). Involucel borne at or above the middle of the peduncle of the flower spike. Interfloral bracteoles not peltate, but composed of a fan-shaped or ovate limb with a hairy margin, borne upon a slender pedicel and forming an imbricated pubescent covering over the flowers before anthesis.

Of the three additional species discussed one belongs to the group *Ceratophysae* and two to the *Globuliferae*.

Acacia dolichocephala Safford, sp. nov. Group *Ceratophysae*, section *Dolichocephalae*. A shrub or small tree resembling *Acacia sphaerocephala* Schlecht. & Cham., but readily distinguished by its elongate flower-heads and fusiform receptacle, as well as by the occasional presence of nectar glands on the leaf-rachis at the base of the terminal and subterminal pairs of pinnae. Young growth puberulent, at length glabrate. Stipular spines ivory white, tipped with brown, broadly divergent and slightly curved outward, terete, tapering gradually to a point, the bases flattened and more or less cuneate, the spines 4 to 5 cm. long, 10 to 12 mm. broad along the line of union of the connate bases. Leaves of vegetative branches composed usually of 10 pairs of pinnae; rachis puberulent, 10 to 14 cm. long, with an elongated

¹ Safford, W. E., "*Acacia cornigera* and its allies." Journ. Wash. Acad. Sci. 4: 356-386. 1914.

crater-like nectar gland on the petiole a little below the first pair of pinnae, often a second, tubular gland below the second pair, and sometimes a gland at the base of the terminal and subterminal pairs of pinnae; leaflets 22 to 26 pairs, assuming a reddish bronze color when dry, oblong-linear, 8 to 10 mm. long, 2 mm. broad, unequal at the base, rounded at the apex and mucronulate, those from which apical food bodies have fallen retuse; midrib prominent beneath, oblique; lateral nerves inconspicuous. Leaves of the flowering branchlets composed of 2 to 5 pairs of pinnae; leaflets 8 to 14 pairs, 3 to 4 mm. long; rachis of leaf with a conspicuous raised nectar gland just below the lowermost pair of pinnae, and frequently a smaller gland at the base of the terminal pair of pinnae. Flowers in ovate-oblong heads or spikes 11 to 15 mm. in length and 8 mm. in diameter at anthesis, usually in clusters of 2 or 3, rarely solitary or in clusters of 4; peduncles graduated in length, thick and fleshy, dark reddish brown, the longest equal in length to the fusiform axis of the head or exceeding it, the shortest less than half as long; involucre 4-toothed, calyx-like, situated at or near the base of the peduncle, puberulent without. Flowers ferruginous, tubular; calyx 1.9 to 2.1 mm. long, 0.5 to 0.6 mm. in diameter, densely puberulent about the margin, obtusely and shallowly 5- or 6-lobed; corolla scarcely exceeding the calyx; stamens numerous, with ferruginous filaments and pale tan-colored anthers; pistil filiform. Pedicelled bracteoles between the flowers with obtuse ovate ciliate laminae, these puberulent on the upper surface; pedicels 1.4 mm. long, when young clothed with sparse short diaphanous hairs, at length glabrate. Pods resembling those of other *Ceratophysae*, inflated, indehiscent, thin-chartaceous, 3.5 to 4 cm. long, 1 cm. in diameter, wine-colored when mature, cylindrical, often slightly oblique, terminating in a sharp spine-like beak, and contracted at the base into a short stipe-like neck.

Type in the herbarium of the Field Museum of Natural History, no. 189552, including flowers and mature seed-pods, collected along the shore north of the city of Vera Cruz, Mexico, January 24, 1906, by Dr. J. M. Greenman (no. 87). A specimen of the type collection with less perfectly developed spines and without seed-pods, is in the United States National Herbarium, no. 692164.

Acacia chiapensis Safford, sp. nov. Group Globuliferae, section Ramulosae. An erect shrub or small tree 3 to 5 meters high, resembling *Acacia Donnelliana* but distinguished from that species by the absence of interpinna nectar glands on the larger leaves and by the more numerous glands at the base of the leaf rachis (petiole). Young growth puberulous. Flower heads globose, borne in axillary clusters on special flowering branches (only very young flower heads observed in the type specimen), covered before anthesis by the imbricate pelate limbs of the pedicelled interfloral bracteoles. Fruit (immature in the type material) a flat strap-shaped legume, somewhat thickened at the sutures, 7.5 to 7.8 cm. long, 7 to 8 mm. broad, terminating in

an obtuse point and narrowing at the base into a stipe-like neck, several legumes radiating from the indurated torus; fruiting peduncle 1.5 to 2 cm. long and (in the type) as thick as the flowering branch bearing it; seeds 12 to 14. Large spines dark brown, V-shaped, terete, tapering gradually to a sharp point, minutely puberulous near the base, at length glabrous and glossy, 50 mm. long, 5 mm. thick near the base, usually perforated and inhabited by stinging ants. Small spines scarcely exceeding 1 mm. in length, puberulent at the base, terminating in a polished reddish point, in the type not acicular as in *A. Donnelliana*. Leaves of the vegetative branches composed of 20 to 26 pairs of pinnae, these 46 to 60 mm. long, sometimes subopposite; leaflets 34 to 44 pairs, linear-oblong, approximate or contiguous, 5 to 5.5 mm. long, 1 to 1.4 mm. broad, usually rounded or obtuse at the apex, unequal at the base, puberulent when young, often spreading nearly at right angles with the rachis of the pinna; main rachis grooved above, puberulent, devoid of nectar glands except at the base, the groove here broader and bearing 10 to 12 irregularly disposed nectaries, some of them apparently geminate. Leaves of flowering branches varying greatly in size, the larger ones resembling the vegetative leaves but with fewer pinnae, and like them devoid of interpinna nectar glands, the succeeding ones sometimes with interpinna glands between the uppermost pinnae, and the smallest bearing 4 to 6 pairs of more or less rudimentary pinnae, nearly all of them with interpinna nectar glands; all floral leaves with a row of 4 to 6 prominent nectar glands at the base of the rachis, and with minute stipular spines subtending the calyx-like buds from which issue the flower heads.

Type in the United States National Herbarium, no. 692157, collected near San Bernardino, between Tuxtla and Chicoasen, state of Chiapas, Mexico, January 12, 1907, by Guy N. Collins (no. 164), in association with *Acacia Collinsii* Safford. At the time of collection (the dry season) nearly all the plants were entirely leafless.

This species, which appears to be intermediate between *A. Donnelliana* of Honduras and *A. multiglandulosa* of Panama, has thin flat pods, and its spines are uniformly quite straight. On the specimen collected nearly all the spines were punctured, but very few of them contained ants. Those that were secured occurred not in colonies but as individuals in the spines.

Acacia multiglandulosa Schenck, Repert. Nov. Sp. Fedde 12: 362. 1913.—Bot. Jahrb. Engler 50: 480. 1914. Group Globuliferae, section Ramulosae. A shrub or small tree with very long narrow bipinnate leaves, some of them provided with large stout polished dark-colored connate stipular spines, these perforated and inhabited by ants, others with minute inconspicuous subulate spines. Large spines (when living) maroon or dark wine-colored, glossy, widely divergent, straight or very slightly curved outward, stout, terete, somewhat flattened at the base, 40 mm. long, 8 to 10 mm. broad at the base. Small spines at the base of equally large leaves scarcely 2 mm. long, minutely

puberulent at the base (when young), glabrous at the blood red point. Leaves of vegetative branches composed of 23 to 31 pairs of pinnae; rachis 20 to 38 cm. long, broadly grooved, with the raised edges of the groove puberulent, and with a single small nectar gland at the base of

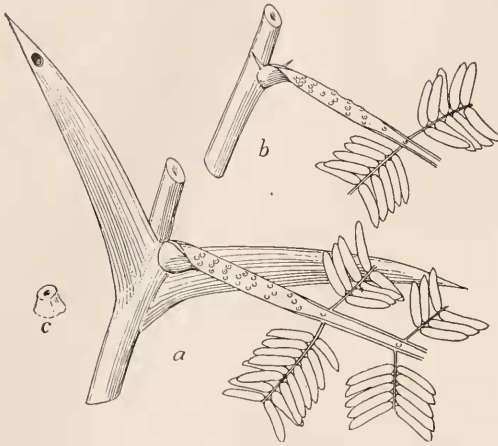


Fig. 1. *Acacia multiglandulosa* Schenck: *a*, enlarged stipular spines, with base of vegetative leaf attached showing numerous extrafloral nectar glands; *b*, leaf base, with minute stipular spines; *c*, nectar gland. Specimen from Panama (Pittier 6745). *a* and *b*, natural size; *c*, scale 3.

each pair of pinnae; groove broadening at the base of the rachis and enclosing 20 to 25 small nectar glands, these arranged approximately in 3 rows, truncate-conoid in form, with a central pore-like opening; rachis of pinnae 30 to 58 mm. long, bearing 25 to 31 pairs of leaflets, these linear-oblong, 5 to 7 mm. long, 1 to 1.1 mm. broad, with only the midrib conspicuous beneath, unequal at the base, and usually obtusely pointed at the apex. Leaves of the flowering branches rudimentary, reduced to small bracts about 1 cm. long subtending the peduncles, bearing minute stipular spines and 4 nectar glands but devoid of pinnae.

Flower heads 7 mm. long, 6 mm. in diameter, solitary or in pairs, borne in the axils of the bracts on long erect branchlets composed of many nodes; peduncles 8 mm. long, 0.75 mm. thick, provided with a basal involucre of 4 connate bracts; form of interfloral bracteoles not observed. Fruit lacking.

Type in the Berlin Herbarium, collected at Porto Bello, Panama, in 1825, by J. G. Billberg. It consists of a flowering branch with several flower heads and two disintegrated leaves, but without enlarged stipular spines. Since the publication of Dr. Schenck's paper upon this group fine specimens of vegetative branches with large spines were collected at the head of Gatún Valley, Panama, in 1914, by Mr. Henry Pittier (no. 6745). The latter are now in the United States National Herbarium, sheets no. 716560 and no. 716561.

In its large leaves, composed of many pinnae, this species resembles *Acacia Cookii*; but the presence of many small glands at the base of the rachis separates it at once from that species, and the arrangement of its flower heads on specialized branches instead of in clusters in the axils of large spines places it in the section *Ramulosae*.

Acacia gladiata Safford, sp. nov. Group Mesopodiales, section Clavigerae. Flower spikes club-shaped, resembling those of *Acacia Standleyi* but much smaller, 10 to 16 mm. long, 4 to 5 mm. thick, densely pubescent before anthesis; peduncles in clusters of 2 to 6, the longest observed 13 mm. in length, pubescent with short straight cinereous hairs both above and below the involucrel, the latter normally calyx-like composed of 4 acute ascending teeth, at first densely pubescent on the outside, at length subglabrous and glossy, usually situated at or above the middle of the peduncle; axis of spike not exceeding the peduncle in thickness. Flowers much darker than those of *A. Standleyi*, but apparently yellow after anthesis, on account of the mass of crowded anthers; calyx broadly tubular, shallowly lobed, tan-colored, hairy about the margin and on the sides; corolla maroon or dark wine-colored, obtusely 5- or 6-lobed, about twice as long as the calyx; sta-

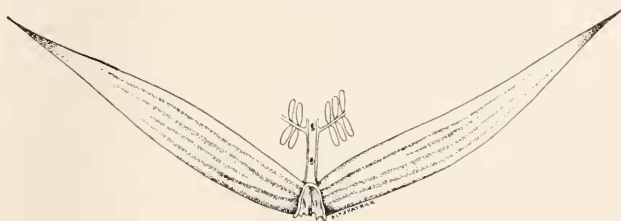


Fig. 2. *Acacia gladiata* Safford. Enlarged stipular spines of vegetative leaf, with base of rachis showing solitary nectar gland. Cotype (Rose 3792). Natural size.

mens exserted, very numerous, the filaments ferrugineous, the anthers pale straw-colored; style filiform, longer than the stamens. Fruit not observed. Large spines very long and widely divergent, usually flattened and sword-like, linear-lanceolate in outline, somewhat constricted at the base, resembling certain forms of the spines of *Acacia cochliacantha* H. & B. but connate instead of separate at the base and never split or inflated, gradually narrowed toward the apex to an acute point, 35 to 52 mm. long, 5 to 8 mm. broad, glabrous, reddish or wine-colored when young, at length brown or tan-colored. Leaves with pubescent or minutely hairy rachis and usually with a nectar gland at its base and just below each pair of pinnae, those of vegetative branches 7 to 10 cm. long, composed of about 20 pairs of pinnae, these 23 to 27 mm. long; leaflets about 20 pairs, oblong-linear, 3.5 to 4.5 mm. long and 1 to 1.2 mm. broad, unequal at the base, rounded at the apex, often mucronulate or tipped with a waxy apical body, as in the true myrmecophilous acacias, the margin at first fringed with small stiff hairs, at length subglabrate. Leaves of flowering branches with short subulate stipular spines and 10 to 16 pairs of pinnae; nectar glands circular or oval, with a raised annular margin.

Type, bearing flowers and old spines, in the herbarium of the Missouri Botanical Garden, no. 46838, collected in the vicinity of Rosario, state of Sinaloa, Mexico, in 1849, by Dr. Josiah Gregg (no. 1135). It is mounted on the same sheet with specimens of the spoon-thorn acacia, *A. cochliacantha* H. & B.

Cotype, a young branch with spines and leaves but without flowers or fruit, in the United States National Herbarium, no. 716563, collected near Acaponeta, Territory of Tepic, Mexico, July 30, 1897, by Dr. J. N. Rose (no. 3792.)

This species is closely allied to *Acacia Standleyi* and to *A. hirtipes*, but differs from them both in its smooth, flattened, sword-shaped spines, and in the form and color of its flowers. Though many of the leaflets of the flowering branches are tipped with food bodies, as in the true myrmecophilous acacias, the spines are much compressed and, in the specimens observed, not inhabited by ants.

ECONOMICS.—*Efficiency as a factor in organic evolution.* I.¹

ALFRED J. LOTKA.

In an earlier issue of this JOURNAL² the writer published a paper on *Evolution in discontinuous systems*. In the first portion of this paper the treatment of the subject was quantitative, and made use of analytical methods. In the concluding section certain phases of the subject were touched upon, for which at that time no method of quantitative analytical treatment could be suggested.

In the present paper it is proposed to resume the thread of the former discussion, and to show how the qualitative analysis of the problem then suggested has since fulfilled the author's hopes in furnishing the basis for quantitative treatment.

To recall briefly the point of view adopted in the paper cited, we note that r , the rate of increase per head of a given type or species of organisms, under given conditions, may be regarded as a quantitative *index* of the *fitness* of such species, or of its *adaptation* to the conditions given.

The value of this index r of the fitness, depends, of course, on the one hand, on the external conditions; on the other hand

¹ Paper read before the Washington Philosophical Society on February 13, 1915.

² This Journal, 2: 2, 49, 66. 1912.